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Dislocation after Revision Total Hip Arthroplasty: A Comparison between Dual Mobility and Conventional Total Hip Arthroplasty

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Purpose: The objective of this study was to analyze the results from a cohort of patients who underwent a revision total hip arthroplasty (THA) using a dual mobility cup (DMC) implant.
Materials and Methods: A retrospective review of revised THAs was conducted using the database from a single tertiary referral hospital. A total of 91 revision THAs from 91 patients were included in the study. There were 46 male hips and 45 female hips. The mean age was 56.3±14.6 years, and the mean follow-up period was 6.4±5.9 years. In performance of revision THAs, the DMC implants were used in 18 hips (19.8%), and the conventional implants were used in 73 hips (80.2%).
Results: During the follow-up period, three dislocations were identified, and the overall dislocation rate was 3.3%. Early dislocation (at one month postoperatively) occurred in one patient, while late dislocation (at a mean of 7.5 years) occurred in two patients. There was no occurrence of dislocation in the DMC group (0%), and three dislocations were detected in the conventional group (4.1%). However, no significant difference in the rate of dislocation was observed between the two groups (P=0.891).
Conclusion: Although the rate of dislocation was higher in the conventional group, there were no statistically significant differences between the two groups due to the small number of patients. Nevertheless, we believe that the dual mobility design is advantageous in terms of reducing dislocation rate and can be recommended as an option for a revision THA.

Key Words: Total hip arthroplasty, Arthroplasty, Hip dislocation, Reoperation, Dual mobility

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INTRODUCTION

Dislocation is the most serious but common complication of revision total hip arthroplasty (THA)[1,2]. Incidence of dislocation as high as 27% after revision THA has been reported. The following conditions have previously been reported as risk factors for dislocation after THA: neuromuscular diseases, dementia, alcoholism, psychiatric illness, prior hip surgery, posterior surgical approach, insufficient abductor muscles, obesity, bony or prosthetic impingement, small femoral head diameter, large femoral neck size, and prosthetic malposition[1-3].

The rate of dislocation following primary THA can be reduced by using a large-diameter femoral head instead of a small-diameter femoral head. The range of motion for impingement is increased by a larger femoral head. In addition, distraction of the femoral head from the acetabulum might be easier with a larger femoral head, which could be helpful in treatment of impingement- and soft tissue-related dislocations.

The popularity of the dual mobility cup (DMC) THA has recently increased. This system is composed of a small femoral head (22 or 28 mm) that is both captive and mobile within a polyethylene (PE) liner A highly polished metallic acetabular shell articulates with a large mobile PE liner ball. This design offers the advantage of reducing cartilage wear, which is a disadvantage of hemiarthroplasty. It also reduces dislocation rate after the arthroplasty. Recently, to reduce the dislocation rate after revision arthroplasty, more and more hip surgeons have grown interests in this design. However, current literature provides minimal information regarding its application in this design.

The purpose of this study is to examine the outcomes in a group of patients who underwent a revision THA using DMC components.

MATERIALS AND METHODS

1. Data Acquisition

This study was approved by the Institutional Review Board (IRB) of Hanyang University Hospital (IRB No. 2023-10-017). Informed consent was waived by the IRB due to the retrospective nature of the study. Information from a single tertiary referral hospital was utilized and cases of revision THA were reviewed in order to identify cohorts using a Structured Query Language (SQL) code-based database query. The clinical database is built on a Microsoft SQL Server, containing data from 2000 to 2021 with a total capacity of 354 GB.

2. Methods

To establish a cohort, patients with the code for revision THA were identified in order to determine which patients underwent revision THA. Collection of demographic data included sex, age, American Society of Anesthesiologists (ASA) ratings, and implant design (DMC and conventional). A group of patients was generated using SQL coding, and datasets examining the demographic data, implant, and presence of dislocation required in this cohort were produced. Perioperative hip radiographs of patients were examined; measurement of postoperative cup inclination, and assessment of lower limb length discrepancies by measuring the distance between the line connecting the bilateral ischial tuberosity (transischial line) and the lesser trochanter were performed.

3. Patients

Patients who underwent revision THA with a conventional or DMC were included. The study included 91 patients and 91 revision THAs performed at our institution between 2000 and 2021. There were 45 female hips and 46 male hips. The mean age was 56.3±14.6 years, and the mean follow-up period was 6.4±5.9 years. In performance of revision THAs, the DMC implants were used in 18 hips (19.8%), and the conventional implant were used in 73 hips (80.2%). Regarding cases of conventional THA, there was 1 case with a head size of 22 mm, 54 cases with a head size of 28 mm, 8 cases with a head size of 32 mm, and 10 cases with a head size of 36 mm, while in DMC THA, the mean diameter of the head (PE liner) was 46.2 mm (range, 42.0-52.0 mm).

4. Outcome Assessment Methods

The procedure code "reduction of hip" was used to identify the dislocation; no radiographic examination was performed. Continuous variables were presented as means and standard deviation and statistical analysis was performed using two-tailed *t*-tests for comparison. A chi-square test or Fisher's exact test was used for evaluation of discrete variables when presented as proportions. Analysis of the outcomes of dislocation was performed using the Cox regression model, and the variables age, gender, implant (conventional THA vs. DMC THA), and head size were included in the model.

A *P*-value of 0.05 was considered significant. Statistical analysis was performed using R ver. 4.3.0 (R Core Team, 2023; R Foundation for Statistical Computing).

RESULTS

Overall, three dislocations were reported, and the dislocation rate was 3.3%. Early dislocation occurred in one patient one month after surgery, and a late dislocation occurred in two patients (54 months and 125 months). Among those cases, 2 cases were implanted with the 28 mm head and the other with the 36 mm head. When analyzed by groups, there were no dislocations (0%) in the DMC group, while three dislocations (4.1%) occurred in the conventional implant group.

According to the results of the statistical comparison, no difference in age (*P*=0.091), sex (*P*=0.461), and ASA score (*P*=0.226) was observed between the conventional implant group and the DMC implant group. However, the follow up period was longer (91.3 months vs. 20.6 months, *P*<0.001) and head size was smaller in the conventional implant group (29.5 mm vs. 46.2 mm, *P*<0.001). No difference in the frequency of dislocation was observed between the conventional implant group and the DMC implant group (*P*=0.891) (Table 1).

Radiographic measurements confirmed a cup inclination of 47.6±8.8°, and a limb length discrepancy (LLD) of –2.0±15.3 mm. Between the dislocated and non-dislocated groups, there were no statistically significant differences in cup inclination (46.2±7.3° vs. 47.6±8.9°, *P*=0.789) and LLD (2.4±4.7 mm vs. –2.2±15.6 mm, *P*=0.614).

The variables age, gender, the type of implant, and head size were used in application of the Cox regression model. The analysis included 91 hips, and 3 dislocations were detected. The overall survival rate of end point with dislocation was 91.7% in 125 months (Fig. 1). The coefficients and their standard errors were estimated as follows: age (coefficient 0.0715, *P*=0.163), sex (male) (coefficient 1.406, *P*=0.317), the type of implant (DMC implant) (coefficient –23.47, *P*=0.999), and head size (coefficient 0.2651, *P*=0.215). The results from calculation of the hazard ratios (HRs) indicated that age had a negligible impact (HR 1.074, *P*=0.163), male sex showed association with a statistically non-significant increase in the hazard rate (HR 4.080, *P*=0.317), the estimate for the type of implant (DMC implant) was inconclusive (HR 6.414×10^{-11}, *P*=0.999), and head size had a minimal effect (HR 1.304, *P*=0.215). The concordance index was 0.873, suggesting reasonable

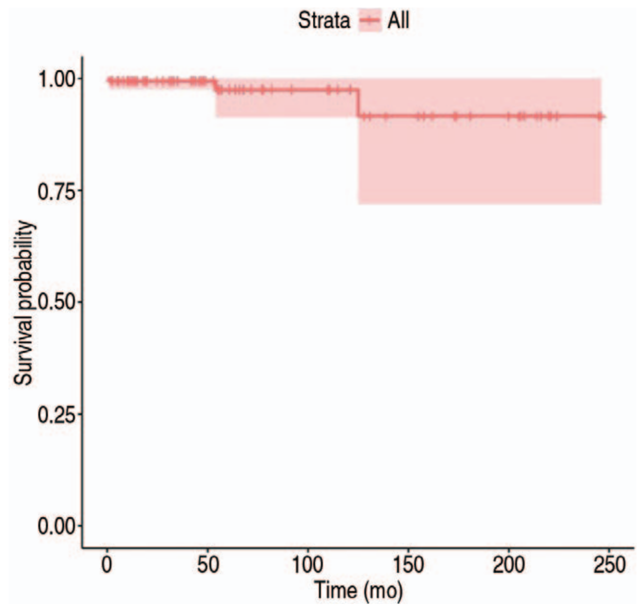

Fig. 1. Survivorship curve using a Cox regression model. Survivorship with the end point of dislocation was 91.7% in 125 months.

Table 1. A Comparison of the Conventional Implant Group and the DMC Implant Group

	Conventional implant group (n=73)	DMC implant group (n=18)	*P*-value
Age (yr)	55.0±15.1	61.5±11.3	0.091
Sex			0.461
Female	38 (52.1)	7 (38.9)	
Male	35 (47.9)	11 (61.1)	
ASA score			0.226
1	12 (16.4)	1 (5.6)	
2	52 (71.2)	12 (66.7)	
3	8 (11.0)	5 (27.8)	
4	1 (1.4)	0 (0.0)	
Follow-up period (mo)	91.3±73.1	20.6±20.1	<0.001
Head size (mm)	29.5±3.0	46.2±2.5	<0.001
Dislocation			0.891
0	70 (95.9)	18 (100)	
1	3 (4.1)	0 (0.0)	

DMC: dual mobility cup, ASA: American Society of Anesthesiologists.

predictive accuracy.

DISCUSSION

Dislocation is one of the most frequently occurring complications after revision THA. Results of this study suggested that the overall prevalence of postoperative dislocation was 3.2%, and no dislocation occurred in the DMC group.

Documented occurrences range between 4% and 30%, thus postoperative dislocation is still one of the most frequently occurring complications following revision THA[4-6]. Several patient- and surgery-specific risk factors have been previously described, including femoral head size, insufficient abductors, surgical approach, component malposition, use of a liner with an elevated rim, cup position, and number of prior hip operations[1,2].

A dual mobility implant is one option used for revision THAs to reduce the risk of dislocation. Although the results using dual mobility implants were first reported in 1986, dual mobility implants were not available for use in the United States until 2009, when approval was granted by the U.S. Food and Drug Administration. In theory, dual mobility implants improve stability by extending the distance between femoral head jumps. Similarly, dual articulation causes changes in the kinematics and reduces the likelihood of dislocation. In THA revision, particularly revision for repeated dislocations, it may benefit the most from using dual mobility components. For several reasons, including repeated dislocation, some studies assessing the avoidance of dislocation with use of a dual mobility design in THA have been reported[7,8]. In a retrospective comparison study of 40-mm large heads versus dual mobility implants with a follow-up period of 3.5 years, Hartzler et al.[8] reported that the risk of dislocation was 3-fold higher in the conventional THA group compared with their dual mobility counterparts, while the risk of re-revision for dislocation was 7-fold higher in the conventional THA group. In a similar manner, Chalmers et al.[9] assessed the survivability and incidence of dislocation of large heads (36 mm and greater) and dual mobility designs in the conversion of THA after hemiarthroplasty. After a 2-year follow-up period, they found that the rate of dislocation was lower in the dual mobility implant group than in the conventional THA group[9]. According to the findings of a systematic evaluation of prospective and retrospective studies by Reina et al.[10], the overall rate of dislocation was 2.2% for revision THAs in the DMC group compared to 7.1% for conventional THAs (P<0.001) at an average follow-up of 4.1 years. Regarding dislocation, the odds ratios were 3.5 higher in the conventional THA group compared with the DMC group (P<0.001)[10]. In our study, there was no occurrence of dislocation in the DMC group following the revision THA, and the overall incidence of dislocation was 0%. However, the low incidence of dislocation could not be verified due to the sample size of the DMC group.

Consequently, the risk of re-revision for dislocation is reduced. However, as with any prosthesis, some issues may arise as a result of the routine application of dual mobility structures in the context of revision. These hazards include the potential for intraprosthetic dislocation, corrosion in dual mobility structures that are modular, and the potential for prolonged wear and consequent loosening[11,12]. Therefore, as with any prosthesis, some issues may arise as a result of the routine application of dual mobility structures in the context of revision.

Our study has several limitations that must be considered. First, diagnostic and treatment code-based medical data stored in hospitals was used for assessment of patient outcomes. The medical data may be incomplete or inaccurate, making it difficult to draw reliable conclusions from the research. The data may also contain inconsistencies or missing values, which can affect the validity and reliability of the findings. Second, the study population was too small to obtain a high level of evidence, and certain demographic groups may more likely seek medical treatment or participate in research projects than others, thus our results may not be typical of the general population. Therefore, the results could be biased, limiting the generalizability of the findings. Third, the confounding variable was not fully considered. Patient data can be complex and there may be various factors that can confound the analysis, such as comorbidities, medications, and environmental factors. Due to the input structure and limitations of storage space for medical data, there was insufficient input of data; therefore, it could not be included in our analysis.

Nevertheless, our research provides several advantages. First, the vulnerability of private data can be minimized by using an SQL code to extract the data required for analysis from hospital data without viewing the patient's sensitive information. In addition, the study's reliability is excellent because the same code can be utilized in order to obtain the consistent outcome. Second, interest in DMC has shown a recent increase, and the outcomes of a revision THA performed within one institution were examined using the data that were not overlooked when using the hospital's medical information system.

CONCLUSION

The overall rate of dislocation after revision THA was 3.2% at a mean follow-up period of 6.4 years, and no dislocation occurred with use of the dual mobility implant. However, because the numbers of cohorts were insufficient to determine a high level of evidence, there was no statistically significant difference in the dislocation rate. Nevertheless, we believe that the dual mobility implant can offer certain advantages in the effort to prevent dislocation and can be recommended as an option for revision THA.

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CONFLICT OF INTEREST

Yeesuk Kim has been an editorial board member since January 2022, but had no role in the decision to publish this article. No other potential conflict of interest relevant to this article was reported.

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